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DESCRIPTION

SCREW-IN ELECTRICAL TERMINAL CONNECTOR

TECHNICAL FIELD

The present invention relates to a screw-in electrical terminal connector adapted in use to be mounted in an electrical device for connecting an electrical cord to the electrical device.

BACKGROUND ART

Japanese Utility Model Unexamined Publication (KOKAI) No. 54-22186 and Japanese Utility Model Examined Publication (KOKOKU) No. 1-41166 disclose conventional screw-in electrical terminal connectors adapted to be mounted in an electrical device.

The former publication discloses, as shown in FIG. 18, a terminal ring **210** and a terminal screw **220** extending through an upper wall **211** of the terminal ring to form a cord gap **G** between the lower end of the screw and a terminal plate supported on a bottom wall of the terminal ring for receiving therein an electrical cord. The electrical cord is squeezed in said cord gap and secured to the terminal plate as the screw is tightened.

The latter publication discloses, as shown in FIG. 19, a terminal ring **310** which is shaped by bending a single metal sheet into a rectangular frame and superimposing the opposite ends of the metal sheet. The opposite ends are secured together with a terminal plate by means of a fixing screw **319**. A terminal screw **320** extends through an upper wall **311** of the terminal ring to have its lower end opposed to the upper end of the fixing screw so as to form therebetween a like cord gap **G**. The electrical cord is inserted in the cord gap and is held thereat as the terminal screw is tightened.

Either of the conventional terminal connector, however, the cord gap has a gap distance which is substantially constant or wider towards opposite ends

of the cord gap with respect to a width direction of the terminal ring. Therefore, when connecting the electrical cord of a stranded wire, i.e., a conductor having a plurality of filaments to the terminal connector, the individual filaments are likely to spread widely on the terminal plate and even escape beyond the ends of the gap as the terminal screw is tightened, failing to be secured to the terminal plate at a sufficient strength.

DISCLOSURE OF THE INVENTION

The present invention has been achieved in view of the above problem to provide a screw-in electrical terminal connector which is capable of holding the stranded wire securely at a sufficient strength. The terminal connector in accordance with the present invention is adapted to be mounted in an electrical accessory **50** such as a switch box, a receptacle, or the like, and includes a terminal ring **10** having a top wall **11**, a bottom wall **14**, and a pair of side walls **12, 13** connecting the top and bottom walls. The side walls are spaced in a width direction of the terminal ring to define a lead-in opening **15** at one of longitudinal ends of the terminal ring for leading in an electrical cord **60** into the ring. The top wall has a threaded hole **17**. The bottom wall is provided with a terminal plate **30** adapted in use to be electrically connected to the electrical accessory. A terminal screw **20** extends through the threaded hole in the top wall to define a cord gap **G** between a lower end of the screw and the terminal plate such that the electrical cord inserted through the opening into the cord gap is held against the terminal plate by tightening of the screw. The cord gap includes a principal zone which is defined to have a width center coincident with an upright axis of the screw and extends in opposite directions horizontally along the width direction to have opposite width ends. The characterizing feature of the present invention resides in that the principal zone is configured to have the opposite width ends which have a gap distance which is narrower than at the width center. Thus, when wiring the electrical cord in the form of the

stranded wire composed of a plurality of filaments, the individual filaments can be concentrated around the width center of the principal zone of the cord gap and be therefore prevented from spreading out of the width ends of the zone of reduced gap distance. With this result, the stranded wire can be securely held against the terminal plate at a sufficient strength. When wiring the electrical cord of a type having one or more core wires having a larger diameter than the filaments, the core wire or wires can be guided into the width center of the principal zone as the screw is tightened. Thus, the electrical cord having one or more rigid cores can be secured to the terminal connector reliably and securely as well.

In a preferred embodiment, the principal zone is configured to have the gap distance which is narrower towards the width ends than at the width center. That is, the gap distance is successively narrowed towards the opposite width ends of the zone for effectively retaining the strands of the filaments around the width center of the zone, which is therefore another object of the present invention.

Preferably, the lower end of the terminal screw is shaped to have a smoothly curved convex, while the terminal plate is profiled to have a lowered surface at a portion corresponding to the width center of the principal zone and a pair of raised surfaces at portions corresponding to the width ends of the zone.

The terminal plate may be formed separately from or integrally with the terminal ring. When the separately formed terminal plate is used, it is advantageous to provide an integral seat on the bottom wall of the terminal ring for stably holding the terminal plate on the bottom wall.

Further, the terminal ring may be formed by bending a single metal sheet into a rectangular shape and engaging opposite ends of the sheet at one of the side wall of the terminal ring. That is, the opposite ends of the sheet define upper and lower parts **40** and **45** of the side wall respectively extending integrally from the top wall and the bottom wall. One of the upper and

lower parts is shaped to have a coupling projection **41**, while the other part is shaped to have a coupling recess **42** for intimate engagement with the coupling projection. The coupling projection is of an inverted T-shaped with a vertical root **42** and a horizontal head **43**. The root projects from one of the upper and lower parts in parallel with the upright axis of the screw, while the head extends horizontally in a perpendicular relation to the upright axis. Since the T-shaped zigzag engagement of the coupling projection with the coupling recess is made in the side wall, the engagement can well withstand a vertical force which results from the tightening of the screw and would otherwise act to separate the engagement.

The zigzag engagement gives a zigzag mating line **Z** between the coupling projection and the coupling recess. Preferably, the zigzag mating line includes at least one oblique segment Z1, Z2 which extends in an inclined relation with respect to the horizontal direction of the ring in order to provide a retaining force of retaining portions, i.e., gate members **49** defined at a corresponding one of the upper and lower parts on opposite of the root of the T-shaped coupling projection of the other part. The retaining force acts to retain the gate members against being deformed in a direction of widening the coupling recess when the coupling projection is caused to move away from the coupling recess by a vertical force developed as a consequence of tightening the screw. Therefore, the engagement can be well retained against the vertical force so as to keep the terminal ring intact and therefore assure reliable wiring connection of the electrical cord to the terminal connector. The provision of the oblique segment in the zigzag mating line gives the above advantage independently of the effect resulting from the specific configuration of the cord slot.

These and still other objects and advantageous features of the present invention will become more apparent from the following description of the preferred embodiments when taken in conjunction with the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view of a screw-in electrical terminal connector in accordance with a first embodiment of the present invention;

FIG. 2 is an exploded perspective view of an electrical device equipped with the above terminal connectors;

FIG. 3 is a partially sectional view of the above connector;

FIG. 4 is a perspective view of the above connector shown with electrical cords of different types;

FIG. 5 is a front view of an electrical terminal connector in accordance with a modification of the first embodiment;

FIG. 6 is a partial perspective view of a terminal ring of the connector of FIG. 5;

FIG. 7 is an exploded perspective view of an electrical terminal connector in accordance with a second embodiment of the present invention;

FIG. 8 is a perspective view of an electrical terminal connector in accordance with a third embodiment of the present invention;

FIG. 9 is a front view of an electrical terminal connector in accordance with a fourth embodiment of the present invention;

FIG. 10 is a perspective view of a terminal plate employed in the terminal connector of FIG. 9;

FIG. 11 is a perspective view of a terminal ring employed in the terminal connector of FIG. 9;

FIGS. 12 to 15 are front views respectively illustrating operations of the terminal connector for wiring connection of electrical cords of different types;

FIG. 16 is a plan view of a side wall of the above terminal ring;

FIG. 17 is a perspective view of the above terminal ring shown with particular indentations made to a mating line in the one side wall of the above terminal ring; and

FIGS. 18 and 19 are views illustrating conventional terminal connectors, respectively.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIGS. 1 to 3, there is shown a screw-in terminal connector in accordance with a first embodiment of the present invention. The terminal connector **1** includes a rectangular frame or ring **10**, a screw **20**, and a terminal plate **30**. For instance, the terminal connectors are mounted in an electrical accessory **50** such as a switch box and a receptacle for wiring connection of an electrical cord to the accessory, as shown in FIG. 2. In this accessory which is the receptacle, three terminal connectors **1** are mounted on the back of a receptacle housing **51** with the terminal plates **30** connected to individual sockets in three slots **52**. The electric cords are wired to the individual connectors for electrical connection of the receptacle to an ac lines. The illustrated receptacle **50** has a switch handle **53** for selective energization of an electrical device plugged to the receptacle, and a cover plate **54**.

The ring **10** is formed by bending a metal sheet and engaging opposite ends of the metal sheet into a rectangular shape having a top wall **11**, a pair of side walls **12**, **13** and a bottom wall **14**. The ring **10** has a width (W) along which the side walls are spaced and a length (L) on opposite ends of which the ring is opened. One of the openings at the longitudinal ends of the ring defines a lead-in opening **15** for introducing the electric cord and the other defines an opening through which the terminal plate **30** is assembled on the bottom wall **14**. The top wall **11** is formed with a countersink or raised rim **16** with an internal threaded hole **17** extending the full depth of the rim **16** and the top wall **11** for threaded engagement with the screw **20**. The screw **20** extends vertically through the top wall **11** at the center of the width of the ring **10** to have its lower end opposed to the terminal plate **30** on the bottom wall **14**, defining a cord gap **G** between the lower end **21** of the screw **20** and the terminal plate **30** for entrapping therein the electrical cord or a conductor thereof.

As shown in FIG. 3, the lower end **21** of the screw **20** is shaped into a

smoothly curved convex of substantially uniform radius of curvature. The terminal plate **30** is also curved along the width direction of the ring **10** to form a concave upper surface **31** with substantially uniform radius of curvature which is shorter than that of the convex lower end of the screw **20**. Thus, the resulting cord gap **G** has a gap distance which is narrower towards opposite width ends of the terminal plate **30** than at a width center thereof which corresponds to an upright axis of the screw **20**. Therefore, when connecting the electrical cord **60** of a stranded wire having a plurality of filaments **61**, the filaments **61** are restrained from escaping out of the width ends of the terminal plate **30** and constrained thereon as the screw **20** is tightened. Thus, the filaments **61** can be secured held between the screw **20** and the terminal plate **30** at a sufficient strength. As shown in FIG. 4, when connecting two types of electrical cords **60** one composed of the filaments **61** and the other composed of a core wire **62** having a larger diameter than the filament, the core wire is held at the width center of the terminal plate while the filaments are concentrated adjacent to the core and are prevented from escaping beyond the width ends of the terminal plate **30**. It should be noted that, although the illustrated embodiment shows the cord gap which is successively narrower towards the width ends of the gap than at the width center, the present invention is not limited precisely to this feature. That is, the cord gap may be formed to have a gap distance which is narrower at the width ends than at the width center.

Turning back to FIG. 3, the ring **10** is configured to leave a small clearance **C** between the side walls **12, 13** and the screw **20**. The small clearance **C** is dimensioned to be less than the diameter of the intended filament **61** in order to provide a safeguard for preventing the filaments from accidentally going into the clearance.

As shown in FIG. 1, the side wall **12** of the ring **10** is formed by engaging the opposite ends of the metal sheet. In other words, the side wall **12** is composed of an upper part **40** integrally depending from the top wall **11**

and a lower part **45** integrally upstanding from the bottom wall **14**. The upper part **40** includes an inverted T-shaped coupling projection **41** with a vertical root **42** and a horizontal head **43** extending horizontally along the length of the ring **10** from the lower end of the root **42**. The lower part includes an inverted T-shaped coupling recess **46** for intimate engagement with the coupling projection. The coupling recess **46** includes a vertical entrance **47** corresponding to the root **42** and a horizontal cove **48** corresponding to the head **43**. These parts are intimately engaged to form a zigzag mating line which provides a resistive force of retaining the engagement against a vertical force applied thereto as a consequence of tightening the screw **20**. Conversely, the coupling projection **41** and the coupling recess **46** may be formed on the sides of the lower part and the upper part, respectively.

FIGS. 5 and 6 show a modified terminal connector which is identical to the connector of the first embodiment except for provision of a seat **18** for supporting thereon the terminal plate. The seat **18** is struck from a portion of the bottom wall and shaped to have a concave upper surface in order to stably support the terminal plate thereon.

FIG. 7 shows a terminal connector in accordance with a second embodiment of the present invention which is substantially identical to the first embodiment except that a ring **10A** is formed from two halves **100** and **110** of U-shaped configuration. Like parts are designated by like numerals with a suffix letter of 'A'. The upper half **100** includes a top wall **11A** and a pair of upper parts **40A**, while the lower half includes a bottom wall **14A** and a pair of lower parts **45A**. The upper parts **40A** is formed respectively with a coupling projection **41A** and a coupling recess **46A**, while the lower parts **45A** is formed with a coupling recess **46A** and a coupling projections **41A**. These projections and recesses are engaged in a manner as in the first embodiment to constitute the side walls with the like zigzag mating line. The bottom wall **14A** is also provided with a like seat **18A** for supporting thereon a like

terminal plate.

FIG. 8 shows a terminal connector in accordance with a third embodiment of the present invention which is similar to the first embodiment except that a terminal plate **30B** is integrally formed with a ring **10B** and is provided with a socket **70** for receiving a prong of an electrical plug. Like parts are designated by like numerals with a suffix letter of 'B'. The terminal plate **30** has a portion common to the bottom wall **14B** of the ring and an extension **36** which extends from the bottom wall to form the socket **70** outside of the ring. The common portion or the bottom wall **14B** are shaped to have a concave surface **31B** which forms a like cord gap with the lower end of the screw as in the first embodiment.

FIGS. 9 to 16 show a terminal connector in accordance with a fourth embodiment of the present invention which is substantially identical to the first embodiment except that a terminal plate **30C** is shaped to have a complex profile. Like parts are designated by like numerals with a suffix letter of 'C'. As best shown in FIG. 10, the terminal plate **30C**, which is formed separately from a ring **10C**, is of generally V-shape with a complex upper concave surface **31C**. The complex surface is composed of a first concave contour **32** at the width center of the plate **30C** and a pair of second concave contours **33** at the opposite width ends of the plate **30C**. The first concave contour **32** provides a lowered surface, while the second concave contour **33** provides a raised surface at a vertical level higher than the lowered surface **32**. The first concave contour **32** has substantially uniform radius of curvature which is smaller than that of the second concave contour **33** and forms ridges **34** at the intersection with the second concave contours **33**. The first and second contours are selected to provide a cord gap **G** with the lower end **21C** of a screw **20C**. The lower end of the screw **20C** has a convex surface of substantially uniform curvature and a beveled edge around the periphery of the lower end **21**. The convex surface defines a major zone of the cord gap **G** with the opposed terminal plate **30C** for holding the electrical cord therein.

Within thus defined major zone of the cord gap, a gap distance is narrower towards the width ends of the zone than at the width center.

When connecting the electric cord having a single core wire **62**, the core wire **62** is retained on the first concave contour **32** of the terminal plate **30C**, as shown in FIG. 9. When connecting the electric cords **60** having the core wire **62** and the filaments **61**, the core **62** is held on the first contour **32** and the filaments **61** are held on the second contour **33** adjacent to the core, as shown in FIG. 12. When connecting the electric cord having the filaments **61**, the filaments **61** are concentrated at and around the first contour **32** of the terminal plate **30C**, as shown in FIG. 13. When connecting the electric cord having a pair of the core wires **62**, the two core wires are retained respectively on the second concave contours **33** as shown in FIG. 14A. It is noted in this connection that even if the two core wires **62** are positioned as shown in FIG. 14B before fully tightening the screw **20C**, the one core wire **62** is forced to move out of the first concave contour **32** to be held on the second concave contour **33** as the screw **20C** is tightened. Once the core wire **62** is moved out of the first concave contour **32**, the ridge **34** acts to retain the core wire **62** in place and to effectively prevent it from moving back onto the first concave contour **32**. Thus, the two core wires **62** can be stably captured to the terminal plate **30C**. When connecting the electric cord having three core wires **61**, one of the core wires is retained on the first concave contour **32** and the other two are retained on the second concave contours **33** as shown in FIG. 15. Thus, the three core wires can be connected stably as well. Also in this embodiment, only a small clearance C is given between the screw **20C** and the side walls **12C**, **13C**. The small clearance C is dimensioned to be smaller than the diameter of the filament **61** to prevent the accidental entry of the filaments into the clearance.

As shown in FIGS. 11 and 16, the ring **10C** is formed from a single metal sheet into a rectangular shape in a manner as described with reference to the first embodiment. Thus, one of the side wall **12C** is composed of an

upper part **40C** integrally depending from a top wall **11C** and a lower part **45C** integrally upstanding from a bottom wall **14C**. The upper part **40C** includes a coupling projection **41C** of a generally T-shaped configuration with a vertical root **42C** and a horizontal head **43C**. The lower part **45C** is formed with a coupling recess **46C** which is shaped in exact registration with the coupling projection to have a vertical entrance **47C** and a cove **48C**. The entrance **47C** is defined between opposed guide members **49** of the lower part **45C**. The coupling projection **41C** is intimately engaged with the coupling recess **46C** to give a zigzag mating line Z. In this embodiment, the mating line Z further includes first oblique segments Z1 and second oblique segments Z2, and third vertical segments Z3, as shown in FIG. 16. The first oblique segment Z1 is defined at the interface between the head **43C** and the guide member **49** to extend in an inclined relation with respect the horizontal, i.e., the length of the ring **10C** in order to develop a retaining force of retaining the guide member **49** against being deformed in a direction of widening the entrance when the coupling projection **41C** is subject to a vertical force which results from the tightening of the screw **20** and acts to pull the coupling projection **41C** from the coupling recess **46C**. The second segment Z2 is defined between the guide member **49** and the upper part **40C** to extend in an inclined relation with respect to the horizontal for developing a like resistive force of retaining the guide member **49** against being deformed in the direction of widening of the entrance **43** under the effect of the vertical force. The third vertical segment Z3 extends from the inner end of the second segment to horizontal segment Z4 defined between the guide member **49** and the upper part 40C for developing the like resistive force. With the inclusion of the first, second, and third segments, the guide members **49** are made reluctant to spread when the coupling projection is subject to the vertical force resulting from the tightening the screw, thereby securely holding the engagement of the coupling projection with the coupling recess and therefore protecting the ring **10C** from being torn apart at the side wall. As a matter of

course, at least one of the first, second, and third segments is effective for assuring rigid engagement between the upper part **40C** and the lower part **45C**.

In order to further enhance the engagement, indentations **19** are made at several portion along the mating line Z as shown in FIG. 11 in order to deform or collapse the corresponding portions of the material forming the side wall. As shown in FIG. 17, relatively wide indentations are alternatively made to zones **19A** including the first, second, and the third segments, partially or entirely.

Claims

1. A screw-in electrical terminal connector for an electrical accessory, said terminal connector (1) comprising:

a terminal ring (10) having a top wall (11), a bottom wall (14), and a pair of side walls (12, 13) which are spaced in a width direction of said terminal ring to connect said top and said bottom walls, said side walls forming therebetween a lead-in opening (15) through which an electrical cord (60) is led into said ring, said top wall having a threaded hole (17), said bottom wall being provided with a terminal plate (30) adapted in use to be connected to said electrical accessory; and

a terminal screw (20) extending through said threaded hole to define a cord gap (G) between a lower end (21) of said screw and said terminal plate such that said electrical cord inserted through said opening into said cord gap is held against said terminal plate by tightening of said screw, said cord gap including a principal zone which has a width center coincident with an upright axis of said screw and extends in opposite directions horizontally along said width direction to have opposite width ends;

said principal zone being configured to have said opposite width ends which has a gap distance which is narrower than at said width center;

characterized in that

at least one of said side walls (12, 13) comprises an upper part (40) integrally extending from said top end wall (11) and a lower part (45) integrally extending from said bottom wall,

one of said upper and lower parts having a coupling projection (41) and the other part having a coupling recess (46) for intimate engagement with said coupling projection,

said coupling projection being configured into an inverted T-shape with a root (42) and a head (43), said root projecting from one of said parts in parallel with said upright axis of the screw, and said head (43) extending horizontally in a perpendicular relation to said upright axis of the screw from a free end of said root;

said coupling recess (46C) being in the form of an inverted T-shape with an entrance (47C) and a cove (48C),

said entrance being shaped for exact registration with said root and being defined between opposite gate members (49) which extend horizontally towards each other from one of said parts,

said coupling projection (41C) engaging with said coupling recess (46C) to define a zigzag mating line (Z) therebetween,

said zigzag mating line including at least one oblique segment (Z1, Z2) which extends in an inclined relation with respect to the horizontal direction of said ring in order to develop a retaining force of retaining said gate members against being deformed in a direction of widening said entrance when said coupling projection is caused to move away from said coupling recess by a vertical force developed as a consequence of tightening said screw.

2. The terminal connector as set forth in claim 1, wherein said principal zone is configured to have a gap distance which is narrower towards said width ends than at said width center.

3. The terminal connector as set forth in claim 1 or 2, wherein the lower end of said terminal screw is shaped into a smoothly curved convex (21), and said terminal plate is configured to have a lowered surface (32) at a portion corresponding to said width center of said principal zone and a pair of raised surfaces (33) at portions corresponding to the width ends of said principal zone.

4. The terminal connector as set forth in claim 3, wherein said lowered surface has a first concave contour (32), and each of said raised surface has a second concave contour (33), and opposite width ends of said first concave contour define ridges (34) at the intersection respectively with said second concave contours.

5. The terminal connector as set forth in any one of claims 1 to 4, wherein said terminal plate (30) is formed separately from said terminal ring (10), said bottom wall (14) having a seat (18) which is struck out from a portion of said bottom wall to have a concave surface on which said terminal plate is placed.

6. The terminal connector as set forth in any one of claims 1 to 4, wherein said terminal plate (30) is formed as an integral part of said terminal ring (10) which is struck out from a portion of said bottom wall.